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Study on the competitiveness and development direction of China's ship-recycling industry under new economic and legal environment

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Study on the Competitiveness and Development Direction of China's Ship-recycling Industry under new Economic and Legal Environment

By

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DECLARATION

I certify that all the materials in this research paper that are not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this research paper reflect my own personal views, and are not necessarily endorsed by the University.

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ABSTRACT

Title of Research Paper: **Study on the Competitiveness and Development Direction of China's Ship-recycling Industry under new Economic and Legal Environment**

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After six decades' development, with the shift of international ship-recycling center, the international ship-recycling industry has made considerable development, now more than 90% of the market is shared by Bangladesh, China, India and Pakistan. In recent years, along with the consensus of improving environmental protection by international society, the gap of international regulations of ship-recycling industry has gradually been filled. In 2009, IMO adopted Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (HKC, 2009), which is expected to come into force in a few years, while European Union has already implemented more stringent ship-recycling bill, with no doubt that "Green Ship-recycling" advocated by China for quite a while will make some advantage the industry in China under new legal environment. Although the global economy is recovering and making progress, the impact of the 2008 financial crisis, especially for the ship-recycling industry, still has a profound influence. As a rule that the depression of shipping industry is the prosperous of ship-recycling industry, further more with the influence of shipbuilding industrial cycle, the international ship-recycling industry is under a growth spurt.

Ship-recycling fits the current trend of energy saving as a model of circular economy, and as a labor-intensive industry, it has great contribution to the employment. As the world's second largest economy and shipbuilding country, discussing of China's attitude and development strategy toward ship-recycling industry under new circumstance, understanding the international competition situation, analysis of the

weaknesses and shortages, is important for ship-recycling industry to play a good role in environmental protection and economic development in China.

Keywords: ship-recycling; competitiveness; Hong Kong Convention; Green ship-recycling

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LIST OF ABBREVIATIONS

LDT	Light Deadweight
GT	Gross Tonnage
VAT	Value Added Tax
DWT	Deadweight
IMO	International Maritime Organization
HKC	Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009
BC	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1989
EU	European Union
EC	European Commission
OEDC	Organization for Economic Co-operation and Development
MEPC	Maritime Environment Protection Committee
SPR	Ship Recycling Plan
UNEP	United Nations Environment Programme
OSH	Occupational safety and Health
PSC	Port State Control
CCS	China Classification Society
EUSRR	EU Ship Recycling Regulation
CNSA	China National Shiprecycling Association
IHM	Inventory of Hazardous Materials
ICIHM	International Certificate on Inventory of Hazardous Materials
SRP	Ship Recycling Plan

SRFP	Ship Recycling Facility Plan
IRRC	International Ready for Recycling Certificate
DASR	Document of Authorization to conduct Ship-recycling
SC	Statement of Completion

1 Introduction

Without any doubt the normal function of our modern life mainly depend on shipping industry. Half of the world will suffer starvation while the other half will suffer frigidity if there were no shipping. With the development of technology and human needs, the world fleet is growing rapidly, which means more and more challenge for the whole and relevant industries to keep safety and environmentally friendly. Ship-recycling industry as a part of it has more than a century's history, and its special feature makes it both energy-saving and threatening the environment, which has drawn IMO and the whole world's great concern in recent years. International and regional regulations have been adopted.

After global 2008 economic crisis, the shipping industry has suffered a serious blow, excess of shipping capacity and aging ships accelerate ship-recycling, resulting in boom development since late 2008 after a four-year's valley, from only 6.34 million DWT of recycling volume in 2007 to 14.56 million DWT in 2008, and reached 58.99 million DWT in 2012 as a peak for that decade (Clarkson Shipping Review & Outlook, 2014). Now the ship-recycling market is still hot, showing no sign of receding.

Table 1 World total demolition (Million DWT)[1]

Year	Tankers	All Bulk	LPG	LNG	Cellular Container	MPP	General Cargo5	Ro-Ro	PCC	Reefer	Passenger	Offshore	Dredgers	Tugs	Total
1996	5.92	15.27	0.04	0.00	0.38	0.13	2.29	0.01	0.01	0.26	0.00	0.04	0.01	0.00	**18.46**
1997	3.57	12.20	0.06	0.02	0.46	0.28	3.14	0.11	0.00	0.12	0.00	0.01	0.01	0.00	**16.43**
1998	6.53	20.69	0.04	0.00	1.55	0.48	2.40	0.10	0.02	0.21	0.01	0.02	0.02	0.00	**25.54**
1999	16.50	26.82	0.07	0.00	0.98	0.65	1.97	0.08	0.02	0.40	0.00	0.18	0.01	0.00	**31.18**
2000	13.99	19.19	0.09	0.00	0.30	0.78	2.20	0.22	0.08	0.18	0.00	0.05	0.00	0.00	**23.11**
2001	15.96	24.96	0.05	0.00	0.63	0.78	2.21	0.13	0.05	0.14	0.00	0.01	0.00	0.00	**28.97**
2002	17.31	24.78	0.51	0.00	1.20	0.64	1.80	0.16	0.02	0.15	0.00	0.05	0.00	0.00	**29.34**
2003	19.68	24.40	0.42	0.00	0.49	0.52	1.72	0.18	0.02	0.18	0.03	0.02	0.01	0.00	**28.01**
2004	8.38	9.01	0.36	0.00	0.17	0.14	1.06	0.11	0.00	0.21	0.00	0.02	0.02	0.00	**11.12**
2005	4.30	5.26	0.09	0.00	0.03	0.05	0.28	0.05	0.00	0.06	0.02	0.24	0.02	0.00	**6.10**
2006	3.17	5.25	0.14	0.00	0.40	0.16	0.67	0.06	0.00	0.09	0.05	0.11	0.01	0.00	**6.94**
2007	3.60	4.14	0.50	0.02	0.37	0.06	0.50	0.08	0.02	0.08	0.03	0.51	0.02	0.00	**6.34**
2008	4.39	10.19	0.52	0.09	1.70	0.25	0.45	0.06	0.06	0.30	0.06	0.89	0.00	0.00	**14.56**
2009	8.64	19.92	0.72	0.00	6.03	1.93	1.55	0.36	1.48	0.40	0.06	1.48	0.00	0.00	**33.92**
2010	13.26	19.80	0.55	0.07	1.95	1.19	1.30	0.90	0.39	0.38	0.09	2.02	0.03	0.01	**28.68**
2011	10.01	35.37	0.31	0.15	1.24	1.67	1.89	0.53	0.17	0.37	0.11	1.48	0.04	0.00	**43.33**
2012	11.86	47.42	0.08	0.14	4.92	1.48	1.45	0.51	0.10	0.61	0.07	2.20	0.01	0.01	**58.99**
2013	11.18	33.81	0.10	0.25	6.23	1.26	1.06	0.59	0.25	0.12	0.06	2.55	0.06	0.01	**46.36**
2014*	1.27	3.52	0.04	0.11	2.13	0.10	0.10	0.04	0.03	0.00	0.00	0.41	0.01	0.00	**6.49**

Source: Clarkson Shipping Review & Outlook (Table 17), 2014

1.1 Aims and objectives

The aim of this dissertation is to make readers realize that although the domestic and international environments are conducive to develop ship-recycling industry, yet based on its own particularity, blind extensive development is not desirable, the government and industry should be cautious to make rational distribution and

[1] For tables from Clarkson Shipping Review & Outlook: Data based on the CRSL world fleet of merchant vessels in excess of 100 GT. Please note that figures do not take into account retrospective changes for Non-Bulk Fleets pre-1996, as indicated by the horizontal line. *Data year to date.

promote healthy development of the industry. The objectives of current dissertation are to:

1. Describe the history and discuss the development of ship-recycling industry.
2. Identify the domestic and international environments.
3. Describe the international regulations and China's domestic legislation relevant to ship-recycling industry.
4. Introduce China's Green Ship-recycling and analyze China's competitiveness with Michael Porter Diamond Model and SWOT analysis.
5. Discuss and analyze the weakness and opportunity of China's ship-recycling industry.
6. Formulate recommendations related to the development of China's ship-recycling industry.

1.2 Background

1.2.1 Ship-recycling industry --- benefits together with hazards

Ship-recycling industry is in accordance with environmental protection concept of modern economy. Ship-recycling industry as a typical circular economy can provide plenty of iron, steel and other materials. More than 0.9 ton of metal will be recycled from every 1 LDT. Using recycled iron and steel instead of iron ore for smelting can reduce air pollution by 85% and water pollution by 96%, furthermore, it can save 1.7 tons of rich ore, 0.68 tons of coke, 0.28 tons of limestone, 15-20 tons/km of shipping capacity per ton of steel smelted, also saving energy by 57%, water by 40% (Wu,2012). So the ship-recycling industry is a veritable "green industry". From the perspective of national economic development, ship-recycling can provide source of

resources; increase government tax; drive the development of waste material processing or other related industries, and provide more employment opportunities. According to the statistics, every 1000 LDT of ship-recycling can provide 1000 employment opportunities directly or indirectly (Wu, 2012). In the second place, ship-recycling can adjust the equilibrium of shipping capacity supply and demand, and promote the virtuous cycle of shipping industry and shipbuilding industry. Table 2 shows approximate estimates of lightship content of different ship types.

Table 2 Approximate estimates of lightship content of different ship types

Ship Type	Size (DWT tonnes)	Gross Tonnage	Lightship (long tons)
Tanker VLCC (older)	270,000	146,000	35,000
Tanker VLCC (newer)	300,000	159,000	35,000
Tanker Suezmax	150,000	80,000	22,000
Tanker Aframax	80-120,000	45-67,000	15-18,000
Tanker Panamax	70,000	40,000	10-13,000
Tanker Handysize	35,000	22,000	7,000
Capesize bulkcarrier	150-170,000	78-86,000	20-21,000
Panamax bulkcarrier	70,000	40,000	10-12,000
Handysize bulkcarrier	35,000	22,000	7,000

Source: (Mikelis, 2007)

On the other hand, ship-recycling is an industry of risking serious environment pollution hazard. Scrap ships usually contain some dangerous wastes, such as variety of oils, Polychlorinated Biphenyls (PCBS), asbestos products, paint and etc., which is likely to cause water, air and soil pollution, and seriously affect the health of workers. Meanwhile ship-recycling is a high-risk operation, and is prone to result in workers' casualties if safety precautions are not in place.

Generally there are 4 measures for ship-recycling:

1. Tidal beaching, as practiced in Bangladesh, India, and Pakistan, who provide about 73% of world's recycling capacity in DWT terms in 2013 according to

Table 3 in section 1.3. It's a very hazard way to environment while dangerous to workers.

2. Non-tidal beaching, as practiced in Turkey, who contributes very little world's recycling capacity, also a dangerous backward way.
3. Alongside, as practiced in China, who provides about 22% of world's recycling capacity in DWT terms in 2013 according to Table 3. This is a much better and safer way than the former two.
4. Graving dock or dry dock, used in very limited cases, in China. Some shipyards like Dalian Shipyard (China) already put it into practice, and this is the future direction of ship-recycling industry.

1.2.2 History of global ship-recycling industry

World ship-recycling industry began in 1950s, after the Second World War. At the beginning countries basically scrapped domestic ships and fishing boats, where the industry center was around north EU, U.S and Japan, with 100-200 million DWT of annual scrapping amount. When it went to late 1960s, due to large quantities of U.S reserved standard transport ships constructed in World War II entering the international market and the proportion of private shipping company's merchant fleet was also increasing, ship-recycling market began to expand from Europe and U.S economic zone to a worldwide scale, with annual scrapping amount increased to over 500 million DWT (Yang, 1993, p.55).

With the increasing scale of ship-recycling market, the scrapping center continues to move. 1953-1963 was the most prosperous decade for Japan ship-recycling, up to 70% of the world's total amount. But after 1976, as the Japanese economy continuously developed, expensive labor cost and environmental cost made ship-recycling

industry decline in Japan, and gradually Japan lost its leading position, the shift of the industry is inevitable (Wu, 2012).

Taiwan and Korea took over the market from Japan and became the new scrapping center since 1960s. The second half of the 70s was the peak period of world's oil tanker scrapping, with the average annual amount of scrapping breaking through 10 million DWT in 1975-1977, even as high as 20 million DWT till 1978, 74% of which were aging handy-size tankers, but the tanker market began to improve since 1979, and recycling quantity decreased by a third compared with 1978. During this period, Taiwan ship-recycling industry had developed rapidly, accounting for 73% of the recycling market, and got the title of "recycling zone", the number of ship-recycling companies even reached 202 (Wu,2012).

In the mid to late 1980s, the world's ship-recycling market presented a second climax and reached 42.5 million DWT as the highest historical record in 1985. However, due to the subsequent improvement of the shipping industry and the rising of new ship prices, the world's ship-recycling amount continued to reduce thereafter and to the valley in 1989, approximately 3 million DWT according to statistics, which was half of 1988's. India relaxed restrictions on the purchase of scrap vessels in 1989, which made a big development of India ship-recycling industry in the downturn, and made it the top of the world. South Korea and Taiwan ship-recycling industry began to decline, the world's ship-recycling center began to shift to India (Wu, 2012).

During the 1990s, the world's ship-recycling market gradual recovered, the average annual recycling amount reached 19.5 million DWT in 1998 and began to enter into the third peak, and maintained an average annual recycling capacity of 27 million DWT until 2003. China almost took 50% of the world market share of ship-recycling

during 1992-1993 to be the first one, but this situation only lasted a couple of years, then China was replaced by India. From 1994 to 2002, India recycled 60% of the world's scrap vessels, and became the world's largest ship-recycling country (Wu, 2012).

After 2000, the ship-recycling industry in Bangladesh made a meteoric rise, and replaced India to become the world's largest ship-recycling country from 2004. in the meanwhile, since 2004 the world's ship-recycling volume decreased rapidly and entered into a phase of sustained recession for four years, until 2007 the average annual ship-recycling volume was only about 6 million DWT. In 2008, a global economic crisis spread, due to the downturn of the shipping market, the world's ship-recycling industry ushered in the spring. World ship-recycling volume boomed in 2009, accompanied by the transfer of ship-recycling center to India. Since 2009, the Indian ship-recycling amount has far exceeded Bangladesh and China, and once again becomes the world's first recycling country. According to IMO statistics, since the 2008 world financial crisis, India, Bangladesh, China and Pakistan make the top four of world's ship-recycling countries, over 90% (Wu, 2012).

1.2.3 History of China’s ship-recycling industry

China's ship-recycling industry began in the early 1960s, mostly with manual labor scrap of only small ships. Then a remarkable development was made after 1980s. From 1984 to 1993, the total import scrap ship reached 10 million LDT which brought hundreds of millions of tax payment. There were more than 200 ship-recycling shipyards in China, with annual capacity of 2.5 million LDT during the peak period. Our ship-recycling volume accounted for about 50% of the world's amount in 1993, ranking the first in the world. When it came to 1994, due to the

international ship-recycling market rat race, international scrap ship price rose from $155 per LDT to $180 per LDT, in the meantime, domestic demand of steel was stabilized, which means scape steel price declined, and just at that point, the state started tax reform, tariffs of import scrap ship rose to 6% with another 17% of import Value Added Tax from 0, leading to an overall decline of ship-recycling industry in China from 1995 to 1997 and nearly 90% of the domestic ship-recycling companies stopped their business, with annual scrap ship import volume hovering around 14 million LDT to 20 million LDT. In 1995 the world's total scrapped volume was about 2.5 million LDT, in which only 0.15 million LDT was contributed by China, accounting for 6.1%. China's ship-recycling industry was at the edge of collapse while India ranked the first. In 1998, preferential policies ruled that the VAT for import scrap ships would be returned after payment and more than 40 companies concentrated on ship-recycling with big scale and good facilities were benefitted. China's ship-recycling industry recovered prosperity because of these policies, and China imported 1.18 million LDT out of 4.66 million LDT of the world's transaction in 2000, accounting for 30.8% and made the second of the world. In 2001, the number was 1.18 million LDT out of 6.01 million LDT, the third of the world (Xu, 2009, p.52).

From 2003, with the recovery of the shipping industry, scrap ship price in international market rapidly increased from around $90 per LDT to $350 per LDT till early 2006, continuous breakthrough to new high, but it did not stop. In the first half of 2008, the price rose to staggering $700 per LDT, doubled just in 2 years. Since 2004, China's ship-recycling industry entered into a long period of hibernation. First nine months of 2008, domestic transaction volume of scrap ship was only 16 thousand LDT, while import amount was less than 150 thousand LDT. After the financial crisis happened, China recycled 8 domestic scrap ships with 9.1 thousand

LDT and imported 12 scrap ships with 113.9 thousand LDT only in October. With the global environmental impact, international scrap ship price fell almost from $700 per LDT to $400 per LDT overnight. By the end of October 2008, the price dropped to $200 per LDT (Xu, 2009, p52).

China recycled 694 thousand LDT of ships in 2008, more than the summary of the previous three years. It increased dramatically to 3.2 million LDT in 2009, 5 times as that in 2008, reaching the highest peak of history. In terms of recycling DWT, China's ship-recycling industry grew from 9.6% to 19.6% from 2008 to 2009, ranking third in the world. And China recycled 220 ships to be the world's second. In 2010 it fell back to 4.3 million DWTs, accounting for 17.45% of the world amount. It raised again in 2011 to 8.6 million DWTs. In the past 5 years, 1354 scrap ships with about 6.3 million LDT have been recycled both domestic and imported, more than 14.5% of the "11th Five-Year" goal. The trade volume is about 11.5 billion RMB (Liu & Guan, 2014).

1.3 Ship-recycling industry status quo and tendency

1.3.1 China vs. other major ship-recycling countries

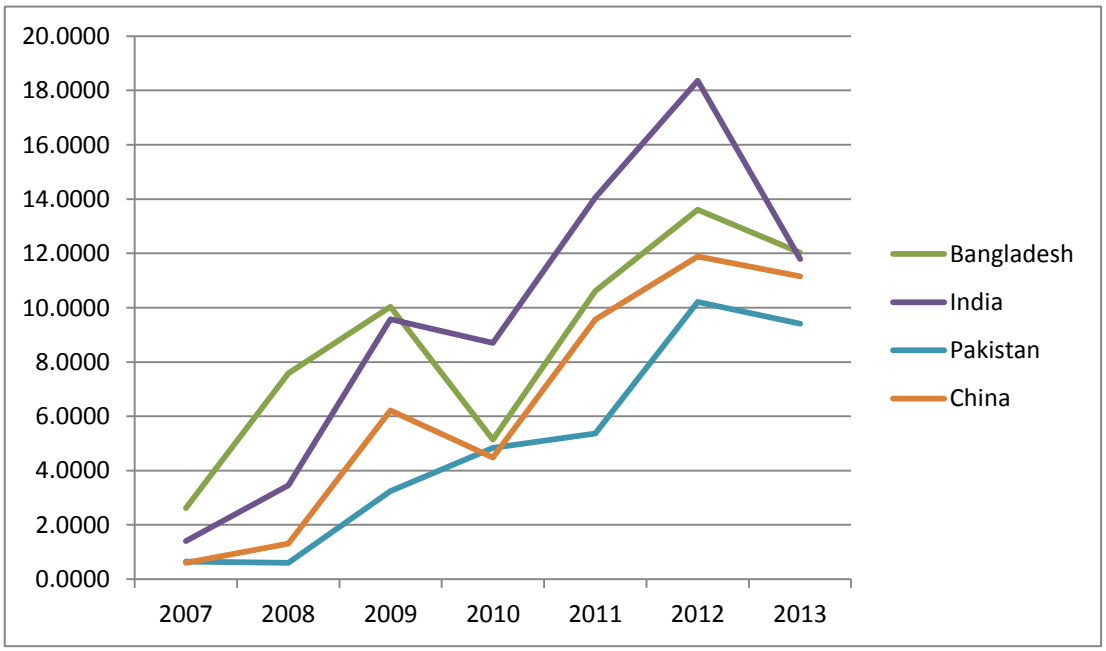
According to statistics, now Bangladesh, China, India and Pakistan are the top four countries of ship-recycling market, accounting for 94% of the world total in 2013. Table 3 shows the detailed number since 2008 economic crisis, there was a peak in 2009 because of mandatory elimination of single-hull oil tankers before 2010 by IMO, and about half of the recycling volume was contributed by that kind of tanker in 2009. Besides that, we can see clearly that the global ship recycling industry is growing at high speed.

Table 3 Ship-recycling amount by major countries

Year	Bangladesh	India	Pakistan	China	World total
2007	2,619,107	1,400,493	646,889	606,795	5,966,920
2008	7,585,586	3,452,769	602,113	1,308,881	14,204,867
2009	10,028,467	9,572,525	3,245,485	6,213,455	33,377,878
2010	5,145,002	8,697,723	4,836,247	4,484,224	28,090,069
2011	10,607,961	14,057,253	5,366,116	9,561,941	42,635,247
2012	13,608,095	18,355,232	10,214,688	11,888,027	58,274,748
2013	12,025,917	11,786,739	9,412,734	11,158,478	47,034,379
2014	3,230,722	5,640,423	3,204,927	3,796,772	17,055,948

Source: Clarkson Shipping Intelligence Network Timeseries, created 09 June 2014

Figure 1 Ship-recycling amount by major countries



The statistics above shows clearly China's position in the world market, for recently

years China has been steady in the 3rd place except slightly fall behind Pakistan in 2008 to be the 4th, and the development fluctuation is quite similar with other countries. Although the gaps between China and the first two are quite small due to India's bigger drop in 2013, for the first half of 2014, India hold the safe lead again.

1.3.2 The tendency of ship-recycling industry

Today, the world ship-recycling industry is still continuing the prosperity since the 2008 finance crisis. First of all, the 2008 economic crisis has a very far-reaching impact on the global economy, especially the impact on international trade. Although national economies of different countries already began to recover, but the shadow of the economic crisis has not completely faded. The international shipping industry is still in the doldrums. Secondly, the cycle of shipbuilding is very long so response to market will lag behind. Shipbuilding orders kept high around the economic crisis, reaching 538.67 million DWT in 2008, more than doubled than 2006's, and got to 618.1 million DWT as a historical peak in 2009, then fell back to less than 300 million DWT until 2013. The growth of world fleet scale began to speed up since 2005, from 49.3 million DWT to 122.4 million DWT of annual growth in 2011, and 62.1 million DWT for the past first quarter of 2014, the speed of the growth will maintain in the near future because of the orders. With no doubt that the increasing new fleet will deepen the excess of shipping capacity under depression time and drive old ships to recycle shipyard. Thirdly, prosperity of shipping industry before the economic crisis leads to plenty of old ships that extend their operation period and are not recycled in time. Fourthly, the high cost of the ship storage while scrap ship price continues to rise in recent years makes it more profitable to sell the scrap ships, so the owners and shipping companies are willing to recycle their old ships for money. Table 4 and Table 5 show the detail.

Table 4 Total World Cargo Fleet (Million DWT)

Year Start	Tankers	All Bulk	LPG	LNG	Cellular Container	MPP	General Cargo	Ro-Ro	PCC	Reefer	Passenger	Offshore	Dredgers	Tugs	Total
2006	**357.4**	**711.4**	11.3	12.7	111.8	24.2	39.6	9.6	7.8	7.4	4.9	39.2	3.9	1.2	**985.5**
2007	**377.2**	**753.9**	11.8	14.9	128.5	25.2	39.9	9.7	8.5	7.4	5.0	43.2	3.9	1.3	**1053.5**
2008	**399.4**	**799.3**	12.4	17.5	144.5	26.4	40.6	9.8	9.3	7.3	5.0	47.5	3.9	1.3	**1125.4**
2009	**421.3**	**846.9**	13.9	22.2	161.5	27.6	41.5	9.8	10.5	7.1	5.2	52.2	4.1	1.4	**1204.2**
2010	**451.5**	**918.1**	14.4	25.9	169.1	27.2	41.6	9.6	10.0	6.7	5.3	55.1	4.2	1.5	**1289.1**
2011	**469.2**	**1015.6**	14.9	28.2	183.8	28.0	41.9	9.1	10.5	6.3	5.3	61.4	4.6	1.6	**1411.5**
2012	**495.3**	**1120.5**	15.1	29.0	196.8	28.5	41.0	8.9	11.2	6.0	5.3	64.6	4.8	1.7	**1533.9**
2013	**514.3**	**1202.3**	15.3	29.0	206.5	28.9	40.1	8.7	11.7	5.3	5.3	66.5	5.1	1.8	**1627.2**
2014	**523.7**	**1251.2**	16.3	30.1	216.2	29.1	40.0	8.4	11.9	5.2	5.4	68.2	5.2	1.9	**1689.3**
Mar-14*	**524.8**	**1259.4**	16.3	30.3	216.2	29.1	40.0	8.4	11.9	5.2	5.4	68.2	5.2	1.9	**1697.8**
Average Growth															
2013-14	**1.8%**	**4.1%**	6.3%	3.8%	4.7%	0.7%	-0.4%	-3.9%	1.1%	-1.8%	0.2%	2.6%	1.0%	2.8%	**3.8%**
2004-14	**5.2%**	**7.1%**	3.9%	12.0%	9.0%	2.4%	0.1%	-1.3%	5.7%	-3.9%	1.5%	7.5%	3.4%	5.5%	**6.8%**

Source: Clarkson Shipping Review & Outlook (Table 8), 2014

Table 5 Total Orderbook (Million DWT)

Year Start	Tankers	All Bulk	LPG	LNG	Cellular Container	MPP	General Cargo	Ro-Ro	PCC	Reefer	Passenger	Offshore	Dredgers	Tugs	Total
2006	**87.35**	**163.17**	3.61	11.05	54.34	3.41	2.70	0.87	2.61	0.12	0.49	3.15	0.15	0.14	**245.84**
2007	**152.13**	**258.68**	5.05	12.45	57.93	6.07	3.16	0.76	3.26	0.14	0.56	4.07	0.22	0.14	**352.50**
2008	**167.77**	**416.73**	4.51	11.90	79.73	8.33	4.82	1.22	4.09	0.20	0.70	5.69	0.55	0.17	**538.67**
2009	**181.59**	**504.13**	3.12	7.38	74.46	9.52	5.49	1.52	3.70	0.24	0.61	6.90	0.81	0.21	**618.10**
2010	**141.57**	**443.82**	1.91	3.52	58.90	7.98	4.75	1.44	2.78	0.18	0.47	7.07	0.83	0.22	**533.88**
2011	**129.37**	**434.65**	1.58	1.59	45.86	7.46	4.34	1.11	2.18	0.12	0.38	8.69	0.78	0.21	**508.95**
2012	**87.19**	**319.61**	1.34	4.66	51.53	5.04	3.13	0.93	1.08	0.04	0.30	10.15	0.58	0.17	**398.57**
2013	**59.57**	**201.02**	2.19	7.20	40.57	2.58	2.03	1.13	0.89	0.03	0.23	11.17	0.28	0.09	**269.47**
2014	**65.20**	**217.81**	4.44	9.17	44.22	2.09	1.07	0.79	1.58	0.01	0.26	10.25	0.16	0.03	**291.94**

Mar-14*	**67.59**	**221.10**	5.71	9.34	43.54	1.99	0.97	0.74	1.67	0.01	0.26	10.16	0.15	0.03	**295.72**

Source: Clarkson Shipping Review & Outlook (Table 12), 2014

Although ship-recycling industry has a long history and the benefits of ship-recycling are the sound one, the working practices and environmental standards in recycling yards often leave much behind. Human behaviors being environment-friendly are more and more desired, so is ship-recycling. After decades of effort, HKC by IMO finally adopted in 2009, sooner or later it will come into force, and the whole industry is facing renewal.

So two things can be expected that the boom of ship-recycling market will continue for quite a long time, and the ship-recycling facilities will have to development quite a lot on both technical and management under mandatory requirements. The market is facing a new round of reshuffle.

1.4 Dissertation outline

This dissertation describes the development of ship-recycling industry, analyzes its characteristics, the importance for China to gain the initiative, identifies and analyzes the domestic and international environment, and tries to find out China's disadvantages and give suggestions. The layout of this dissertation is:

Chapter 1: Introduction. This chapter identifies the aim and objectives of the study, and describes the history, status quo and tendency of ship-recycling industry.

Chapter 2: International legal framework of ship-recycling industry, which introduces the history, background and development of international legal framework

of ship-recycling industry, analyses the advantage and disadvantage of the major regulations to some extent.

Chapter 3: Legal framework of ship-recycling industry and Green Ship-recycling in China, which introduces the history, background and development of China's legal framework of ship-recycling industry, also the development of China's green ship-recycling, and discusses the backwardness.

Chapter 4: China's competitiveness analysis. This chapter uses Michael Porter Diamond Model to analyze China's competitiveness compared with India, which might be the biggest competitor. And furthermore, SWOT analysis will be used to figure out the advantages and disadvantages of China's ship-recycling industry.

Chapter 5: Conclusion and Recommendations, which concludes the dissertation and formulate recommendations on promoting development of China's ship-recycling industry.

2 International legal framework of ship-recycling industry

2.1 Background of the HKC

The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (2009) is a mile stone of world's ship-recycling industry, after decades of efforts made by different organizations and the desire of the international community to build a safer and environment friendly ship-recycling industry. Before the HKC was born, IMO, ILO and BC tried to regulate ship-recycling industry with international regulations, codes or guidelines from their concern.

2.1.1 The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989) administered by the United Nations Environment Programme (UNEP) is a part of the United Nations system. The Basel Convention regulates the transboundary movement of hazardous and other wastes listed in Annexes I and II of the Convention. The BC protects the environment and the human health against damages that result from the generation and management of hazardous and other wastes. The convention was adopted in 1989, which entered into force in 1992, and which currently has 178 Parties. But this convention does not deal with

ship-recycling industry, in particular, it focuses on regulating the international movement of hazardous wastes, protects developing countries from importing hazardous wastes that they are unable to manage in an environmentally sound manner. Scrap ships just can be treated as a kind of hazardous waste.

In 1994, parties of the BC adopted the “Ban Amendment” to strengthen the protection of developing countries with banning export of hazardous waste from OECD to non-OECD countries. The Ban Amendment came into force until 2007 through the European Waste Shipment Regulation. Parties to the BC realized that recycling of end-of-life ships should be regulated by the convention, so the BC approved voluntary guidelines for the ship-recycling industry, “Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships”, in December 2002.

However, the BC didn’t develop regulations for recycling ships because there were practical and legal difficulties in enforcing the Basel Convention to ships. One obvious example is EU where the Convention is implemented along with the ban amendment, forbidding the export of hazardous wastes, including ships, to non-OECD countries, where most of the world ship-recycling industry is located. The BC guidelines focus on environmental harmlessness during ship-recycling.

2.1.2 Guidelines by the ILO

"Safety and Health in Shipbreaking: Guidelines for Asian countries and Turkey" was approved by the 289th session of the International Labour Organization's Governing Body in March 2004. ILO was established in 1919 under "Peace Treaty of Versailles" and became a specialized agency mandated to set standards on occupational safety

and health (OSH) for all workers within UN system in 1946, the party delegations should be made up by the government, workers and employers, and vote independently.

The guidelines include comprehensive occupational health and safety issues at work, try to reduce injuries and related diseases, strengthen the protection of ship-recycling workers. However, it is also a voluntary guideline, besides, although other conventions by ILO do not directly applicable to ship-recycling industry, but they can be indirectly applicable.

2.1.3 Code by the IMO

"Industry Code of Practice on Ship-recycling" was adopted on 5 of December, 2003 at the 23 regular session of the Assembly of IMO by resolution A.962(23). IMO is a specialized agency of UN responsible for maritime safety and marine pollution by ships, for the purpose of promoting shipping technical cooperation between countries, encouraging countries to enhance maritime safety and improve the efficiency of shipping, unifying standards to prevent and control pollution of the sea from ships, and dealing with legal issues. The subordinate body MEPC is responsible for coordinating the prevention and control of pollution from ship activities.

IMO Marine Environmental protection Committee pays its attention to ship-recycling at its forty-second session (MEPC 42) in 1998 firstly, and then at the MEPC 43 the committee incorporated the issue of shipbreaking into work plan. At the MEPC 49, the Committee adopted a resolution on the ship-recycling guidance and submitted it to IMO, and the 23 regular session adopted the guidance, A.962(23).

IMO guidelines give requests for every stage of ship life, including ship design, construction, operation and the preparation for recycling, to carry on management to each stage in order to reduce the occupation safety and environmental pollution risk.

It is worth mentioning that all the guidelines above are voluntary, furthermore, ship-recycling industry is mainly located in developing countries where the recycling equipment, technology and management are relatively lagged behind, and there is a big distance between the guidelines and reality. Besides, implementation of the guidelines will undoubtedly lead to increase of operating costs, and weaken competitiveness of the ship-recycling yards in the market. Therefore, consciousness and initiative for the ship-recycling companies to follow the guidance are greatly affected. In addition, none of the provisions of the three guidelines is comprehensive, and each guideline focuses on its own area. In order to fully and thoroughly address health, safety and environmental problems caused by ship-recycling industry, IMO decided to make a mandatory convention on the basis of ship-recycling according to the above guidance in cooperation with ILO and BC, to develop a ship-recycling convention.

2.2 Development of the HKC

After interagency co-operation with ILO and BC, IMO realized that a new mandatory instrument on recycling of ships should be developed, and in November 2004 MEPC 52 made some preparation like making hazardous materials list, approval of Ship-recycling Plan, consideration of establishing ship-recycling fund, set up Joint ILO/IMO/BC Convention Working Group to make possibilities for them to consult, co-ordinate and co-operate technically on ship-recycling issues from their programs and obligations. In February 2005, the Joint Group held their first session

at IMO. In July 2005 MEPC 53 agreed to provide mandatory and globally applicable regulations for ship-recycling, including considering recycling facilities as priority. Then the 24th regular session of the Assembly on 1 of December, 2005 adopted resolution A.981(24), "New Legally Binding Instrument on Ship-recycling", MEPC was requested to develop a mandatory instrument for deliberation and adoption in the biennium 2008-2009. In the second session of the Joint Group held in the same month by the Basel Convention Secretariat, Norway submitted a draft text of mandatory convention about ship-recycling with safety and environment sound way. In March 2006, the MEPC 54 convened a working group to discuss and further develop the draft text. And after that, several meetings were arranged for further development of the draft text by working group and intercessional working group, from MEPC 55 to MEPC58 held in 2008. In May 2009, the International Conference on the Safe and Environmentally Sound Recycling of Ships was successfully held in Hong Kong as planned, and the convention named “Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships” was adopted unanimously by 63 sovereign governments attending the Conference. The HKC is the first convention approved in China, and it is a record that it took 3 years and 2 months for the draft text to be adopted as the Convention (Mikelis, 2012).

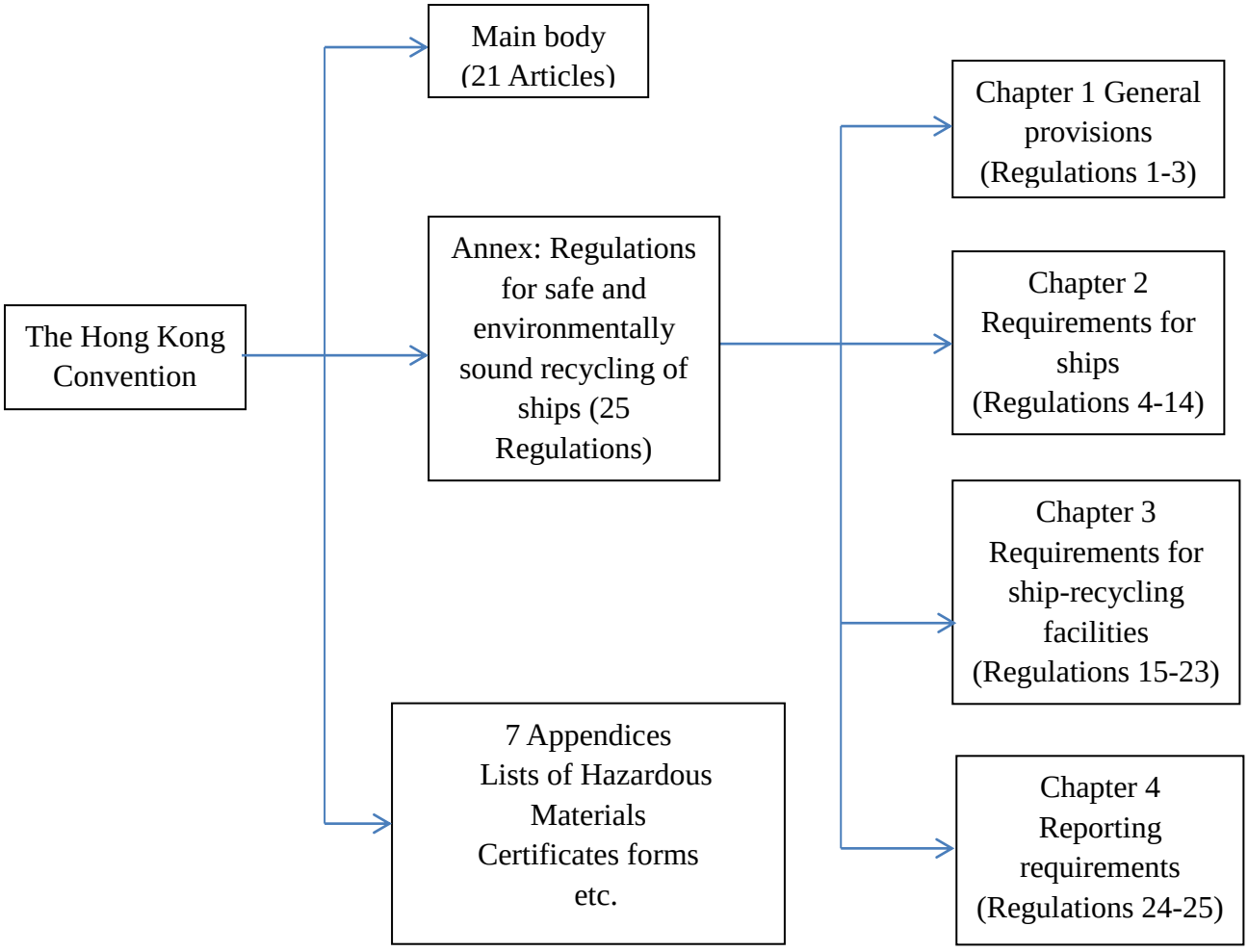
There was long discussion and argument on whether the HKC is equivalent to the BC from Conference of the Parties (COP 9) in 2008 to COP 10 in 2010, and not much consensus reached. COP 10 adopted decision BC-10/17, which declared that: (i) notes that there was no agreement on equivalency; (ii) calls for early ratification and entry into force of the Hong Kong Convention; and (iii) notes that the Basel Convention has a role to play in the management of waste streams from ships. IMO certainly felt comfortable that the decision encourages BC parties to ratify HKC but at the same time it is difficult to convince the states who did not support the

equivalency of both conventions. None of these states has ship-recycling industry or involvement in international trade of shipping, so the difficulty can be imagined. Anyhow, the HKC is a much more comprehensive and targeted convention that concentrates on ship-recycling compared BC, and its effectiveness is for sure.

2.3 The structure of the HKC

The HKC includes: 21 Articles, the main legal framework; 25 Regulations, four chapters of technical requirements; 7 Appendices, Lists of Hazardous Materials, certificates forms and etc.

Figure 2 Structure of the HKC



Besides, there are 6 non-mandatory guidelines already adopted separately about providing clarifications, interpretations, and uniform procedures for technical issues to support the HKC, four of which are to assist states in the early implementation of the Convention's technical standards:

2011 Guidelines for the Development of the Inventory of Hazardous Materials, adopted by resolution MEPC.197(62);
2011 Guidelines for the Development of the Ship-recycling Plan, adopted by resolution MEPC.196(62);
2012 Guidelines for Safe and Environmentally Sound Ship-recycling, adopted by resolution MEPC.210(63); and
2012 Guidelines for the Authorization of Ship-recycling Facilities, adopted by resolution MEPC.211(63). (IMO Website, 2014)

And another two are to assist States in the implementation of the Convention after it enters into force:

2012 Guidelines for the survey and certification of ships under the Hong Kong Convention, adopted by resolution MEPC.222(64); and
2012 Guidelines for the inspection of ships under the Hong Kong Convention, adopted by resolution MEPC.223(64). (IMO Website, 2014)

2.1.4 The main elements for mechanisms and core part of HKC

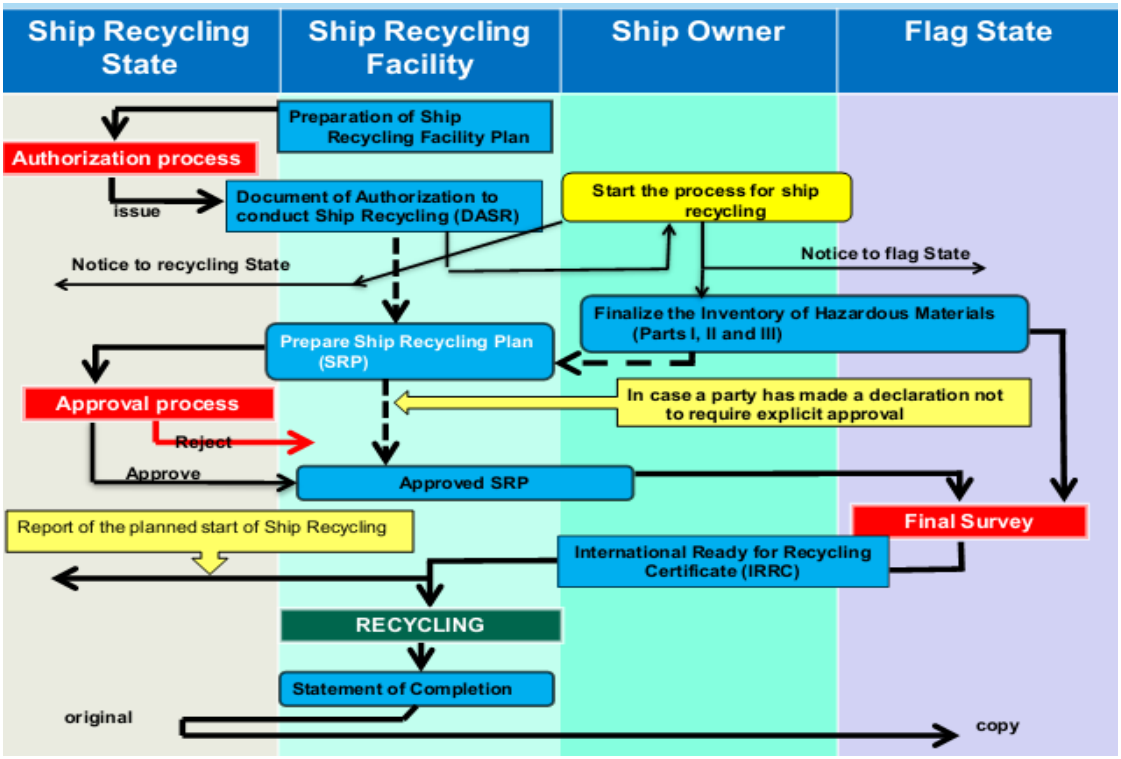
The HKC is not just for scraping of ship, but regulating the whole ship-life, from cradle to the grave, to minimize the environmental pollution risk of hazardous materials on board, and enhance occupational safety and health of ship-recycling

facility workers. And there are several elements to make the mechanisms work:

- Inventory of Hazardous Materials (IHM), which has three parts: Part I for hazardous materials listed in Appendices for whole ship-life, Part II for operationally generated wastes and Part III for stores that are prepared before recycling. Part I has a different scope for new ships and for existing ships.
- International Certificate on Inventory of Hazardous Materials (ICIHM), issued by flag State or Competent Authority after initial or renewal survey and valid for 5 years, following Harmonized System of Survey and Certification like other IMO certificates.
- Ship-recycling Plan (SRP), a plan based on ship's IHM and other particulars and prepared by ship-recycling facility, usually approved by Competent Authority.
- Ship-recycling Facility Plan (SRFP), a plan describing the system and processes of the ship-recycling facility to ensure safety and environmental sound, adopted by the board or the appropriate governing body of the Recycling Company.
- Document of Authorization to conduct Ship-recycling (DASR), a document issued to the ship-recycling facility by its State's Competent Authority, valid for 5 years.
- International Ready for Recycling Certificate (IRRC), issued to ship by flag State or its Competent Authority after final survey for recycling on basis of IHM and SRP, valid less than 3 months.
- Statement of Completion (SC), issued by the Ship-recycling Facility and reported to its Competent Authority after partial or complete recycling of a ship is completed, then to the Administration that issued IRRC. The Statement shall be issued within 14 days of the date of partial or completed Ship-recycling with incidents and accidents report, if any.

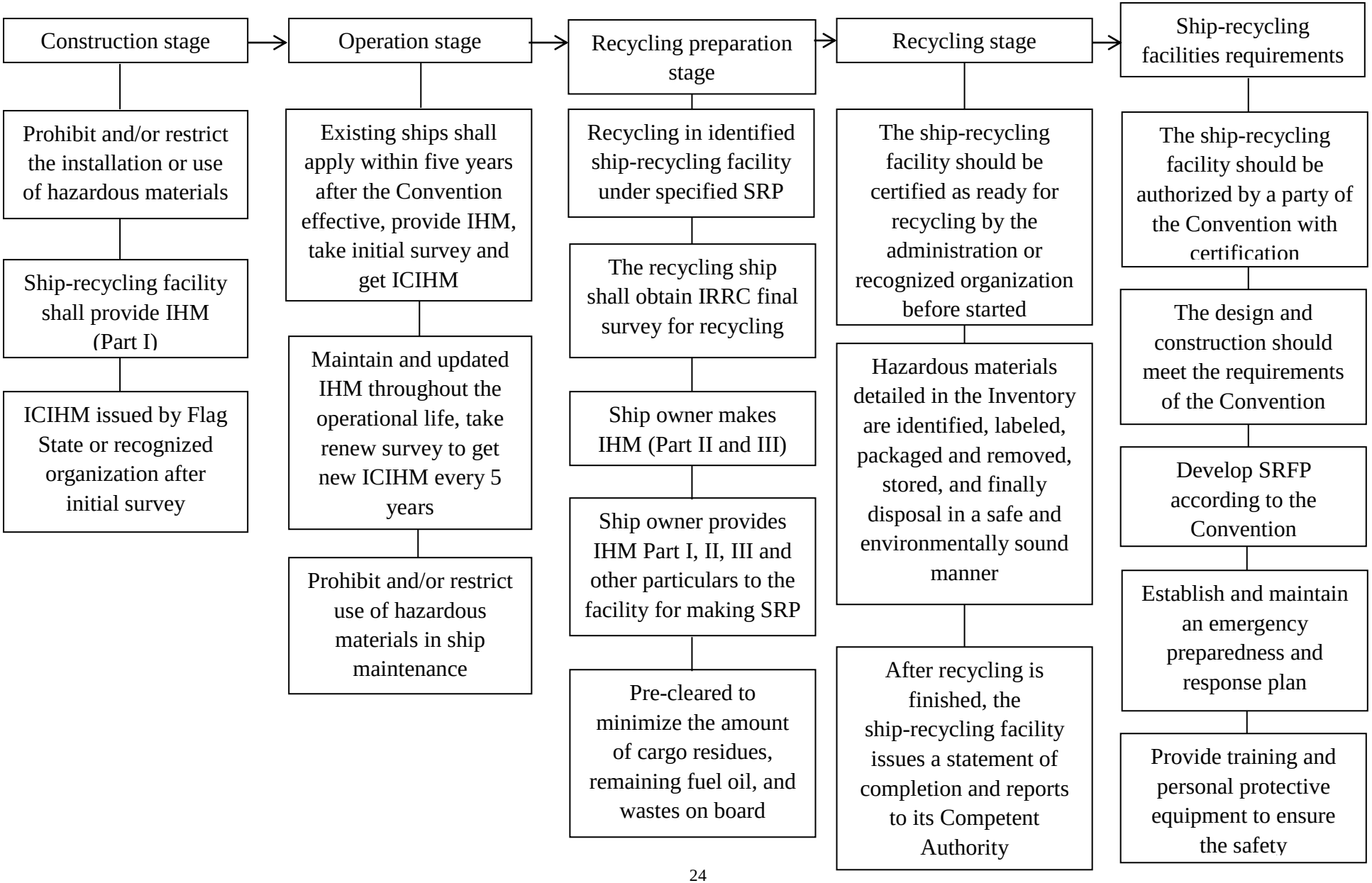
The Annex (Regulations for safe and environmentally sound recycling of ships) is the core part of the Convention, and it involves ship design, construction, operation, maintenance and recycling stages, and regulates handling of hazardous materials on board, ship-recycling equipment requirements, ship-recycling process control, ship-recycling workers' safety and training, and emergency response measures in detail. It standardizes the management of safety and environmental sound ship-recycling, bans the installation and use of some hazardous materials on ship, increases the ship-owners and ship-recycling facilities' obligation on safety and environmental protection, makes the recycling facilities' design, construction and operation standard clear, strengthens supervision and regulatory of flag state to ship and recycling state to ship-recycling facility.

Figure 3 Requirements for different parties



Source: Mikelis, 2012

Figure 4 Requirements for different stages



2.5 The status of the HKC

The Convention is open for access by any state. It will enter into force 24 months after the date on which 15 states, representing 40 per cent of world merchant shipping by gross tonnage, have either signed it without reservation as to ratification, acceptance or approval or have deposited instruments of ratification, acceptance, approval or access with the Secretary-General. Furthermore, the combined maximum annual ship-recycling volume of those states must, during the preceding 10 years, constitute not less than 3 per cent of their combined merchant shipping tonnage (IMO website, 2014). By 31 of May, 2014, there are 5 signatories, France in 2009, Italy, Netherlands, Saint Kitts and Nevis and Turkey in 2010. And two contracting states, Norway in 2013 and Congo in 2014, constitute approximately 1.46 % of the gross tonnage of the world's merchant fleet (IMO, 2014).

2.6 New Ship-recycling Regulation of EU

There is no doubt that Europe is leading the shipping industry, whether it is technological progress or international regulations-making, European countries played a huge role in promoting Hong Kong Convention. EU is concerned about the green, environmental and safety issues all the time, and acts actively in promoting the establishment and improvement of global green ship-recycling activities and regulations. Historical facts of EU Ship-recycling Regulation:

- The EU Ship-recycling Regulation was published in the Official Journal of the EU on Tuesday 10 December 2013. It entered into force on 30 December 2013; while its different articles apply at different stages, all detailed in article 32 of the Regulation.

- The European Parliament had formally adopted the Regulation in plenary on 22 October 2013, followed by the Council on 15 November.
- On 11 July 2013, the new law was backed by the Environment Committee of the European Parliament.
- On 27 June 2013, the Council had endorsed a compromise text of the new Ship-recycling Regulation agreed with the European Parliament (European Commission, 2014).

Soon after the HKC was adopted in May 2009, some European ports, such as Rotterdam have fulfilled all the terms of the HKC, and that ships enter this countries are required to have IHM. EU gets ahead in implementation of the HKC.

Admittedly, the development of the HKC has filled the gaps in the international legal regime for ship-recycling industry, ending a long history of no uniform standards era of the industry, and becoming a major move of promoting safety, environmental protection, occupational safety and health of shipping industry. However, as mentioned, the criteria for the HKC to enter into force are quite strict, unless approved by the world's biggest ship-recycling countries, otherwise there will be a long way to go. But the implementation of the Convention will undoubtedly increase the recycling costs and reduce international competitiveness greatly, thus the countries still remain in a hesitant attitude. So the purpose of EU to make a regional regulation to get ahead of the HKC is obvious.

According to EU statistics, the global EU fleet of 500 GT and above accounts for 17% of the world’s fleet, about 8,500 merchant ships. Although some member states have ship-recycling industry like England, French and Netherland, also Turkey (OECD member), the ability is far beyond demand. With the expectation that ship-recycling

demand will continue to grow, 1.6 to 2 million LDT of average annual recycling capacity will be needed for recycling EU flag ships. Approximately 1 million LDT of ships need to be recycled in non-OECD countries per year (Zhang, 2013, p.16). Therefore, EU is badly in need of ship-recycling companies with appropriate conditions in non-OECD countries. At the same time, the birth of new EU Ship-recycling Regulation will constitute a constraint on EU ship-owners, and make EU ship-owners to pay attention to green ship-recycling — by following the regulation to improve the recycling standard, reducing environmental pollution.

Senior engineer Fan Yunzhi from CCS said that the main purpose of the EUSRR is to develop a regulation against EU flag ship scrapping, aiming at implementation before the HKC, to imply green construction and recycling of EU flag ships as soon as possible (Zhang, 2013, p.16). The EUSRR is based on the HKC, but with higher requirements to ships themselves and green ship-recycling compared with the HKC.

1. Beaching is forbidden by the EUSRR, which is not mentioned in the HKC.
2. For IHM, the new EUSRR only has 1 appendix to categorize hazardous materials compared with 2 appendices of the HKC, but it has a wider range, and has more specific requirements for each type of hazardous material.
3. EUSRR sets very high and detailed requirements for ship-recycling facilities, and in the meantime EU flag vessels cannot be scrapped in the facility which is out of the authorized ship-recycling facility list by EU. And on-site inspection and certification must be taken when a non EU or OECD member's ship-recycling yard wants to take a place in the list. Authorized recycling facilities not only need to meet the HKC, but also to meet additional requirements of the new EUSRR, such as full-process control of all hazardous wastes.
4. Meanwhile, different from the HKC, there is a proposal that taxation from every

> ship that visits EU ports. Although it has been ultimately rejected, European Parliament still calls on the Member States regulatory agencies to implement a "reward mechanism" to encourage safe ship-recycling by 2015, to offset the cost brought up by green ship-recycling for the ship-recycling facilities. (Zhang, 2013, p.18)

If the new EUSRR which is a as a regional regulation came into force on schedule, whether it will promote or hinder the implement of the HKC because of more stringent terms is still under argument, but there is no doubt that it will be combined with the PSC and other manners after taking effect, both ship operation and recycling will be influenced greatly.

3 Legal framework of ship-recycling industry and green ship-recycling in China

3.1 China's legal framework

In order to facilitate the development, the concept and practice of green ship-recycling is continually promoted in China. A series of instruments on ship-recycling have been issued: Regulation on Prevention of Environmental Pollution from Ship-recycling (the Regulation), issued by the State Council in1988; General Standards for Green ship-recycling (the Standards), issued by the National Development and Reform Commission in 2005, Technical Guidelines on Environmental Pollution Prevention of Ship-recycling by China National Shiprecycling Association, Regulation on Prevention of Marine Pollution from Ship, effected on 1 March 2010, etc. (Xu, 2010)

3.1.1 Regulation on Prevention of Environmental Pollution from Ship-recycling

Regulation on Prevention of Environmental Pollution from Ship-recycling is the first regulation of China on ship-recycling, issued by the State Council on 18 May, 1988, and came into force on June 1 the same year. China's ship-recycling industry achieved development under the government government's support in 1980s, along with increasingly serious environmental pollution. In order to reduce the pollution

and protect the environment, the State Council enacted the regulation to supervise ship-recycling industry. The Regulation contains 28 articles which regulate the location of ship-recycling yard, recycling related activities, etc. The pollution liability is also included.

The Regulation requires recycling facilities to locate with comprehensive consideration and planning to distribute rationally, and locate these facilities to areas protected or where wastes are easily to diffuse is limited or prohibited. In addition, the ship-recycling facility must develop an environmental impact report containing location, surrounding environmental conditions, ship-recycling scale, ship-recycling technology, pollution prevention measures, expected results of the measures and so on for the environmental protection department to approve, otherwise these facilities cannot operate. After the establishment of a ship-recycling facility, pollution prevention facilities like oil containment boom, waste oil reception equipment, oily water treatment equipment, waste recycling and disposal area, etc. must be set up and accepted by the environmental protection department. The scope of the Regulation is more emphasis on environmental protection, including per-cleaning, pollution prevention and cleaning up after recycling, no particular requirements for workers' safety and protection. Furthermore, the Regulation defines the pollution liabilities, according to the intention and damage, respectively, and provides civil liability, administrative liability and criminal liability.

The Regulation sets requirements for ship-recycling facilities from construction to operation, but is too old to follow the development of ship-recycling industry and peoples' desire of safety and environmental friendly. Some of the provisions seem outdated, such as the definition of ship-recycling which puts more emphas on scrapping, with no clear division to supervise departments' duty, no concern about

ship operation, workers' training and protection is not included. The Regulation lacks enforceability and operability, and needs to be renewed.

3.1.2 General Standards for Green Ship-recycling

In order to better regulate ship-recycling, ensure the workers' occupational safety and health, and protect environment, CNSA developed the first industrial standard for ship-recycling industry, General Standards for Green ship-recycling. The Standard was issued and implemented by the National Development and Reform Commission in 2005.

The Standards developed according to 13 National Standards (including discharge of sewage, hazardous waste management, and occupational health and safety management), the Regulation, the BC and so on, from the aspects of environmental protection, safety production, securing workers' health to regulate ship-recycling companies. (Zhang, 2013, pp. 16-19)

1. Environmental protection. The Standards forbid dismantling vessel on beach for the first time, and eliminates simple boatyard ship dismantling. But in the regulation, dismantling vessel on beach is a method of ship-recycling, so it is clear that the Standards is more advanced than the Regulation, even in front of the HKC, the same as the new EUSRR. During ship-recycling, the Standards requires to follow the national standards: sewage control should meet Integrated Wastewater Discharge Standard; air pollution control should comply with Integrated Air Pollutants Discharge Standards; solid waste pollution control, for occupational safety and health incineration and disposal should be regulated by Standard on Pollution Control of Hazardous Waste Incineration and Standard on

Control of Hazardous Waste Landfill; noise pollution control should follow Standard on Noise of Industrial Enterprises and Standard on Noise of Urban Region.

2. Requirements for safe production. The requirements about safety production in the Standards are developed in accordance with Production Safety Law of R.P.C. For ship-recycling safety production, with the principle of safety first and prevention first, the ship-recycling facility should establish safety management department to carry out safety education, certificate the operational workers. Safety production facilities and equipment should be available. These should be regular labor protection supplies, and the equipment must be maintained in time to ensure normal function. For management, on-site safety supervision should be strengthened, and safety problem should be solved right after identification of the reasons.
3. Occupational safety and health. Ship-recycling workers should be provided with enough labor protection equipment, clinic with simple equipment and regular medicines should be established, and these should also be periodic medical examinations for workers. For workers engaged in asbestos-containing waste and cutting operation, special requirements of the Standards should be followed. Besides, appropriate emergency measures and accident prevention measures also should be taken to protect workers.

In summary, the Standard is more detailed and feasible than the Regulation, and more comprehensive with occupational safety and health added. The principle of the Regulation is only on the environmental protection of ship-recycling while the Standard's is "To regulate and guide environmental friend and safety behavior of ship-recycling industry, encourage ship-recycling companies to attach importance to environmental protection, safety production and human health protection, promote

green ship-recycling, to achieve sustainable development of China's ship-recycling industry." The development of the Standard shows the emphasis on green ship-recycling and develops endeavor of China, which meets the trend of the development of the world's ship-recycling industry, and makes China take advantage among world biggest countries. Although the Standards is a mandatory industry standard (10, p14), there are no sanctions requirements for violation.

3.1.3 Other legal instruments

Rules on Safety Production and Environmental Protection of Ship-recycling was issued by Material Ministry in 1990. The Rules requests that skilled workers employed by the facility itself should not be less than one-third; technical scheme and work plan should be made before recycling started and the ship-recycling should establish a safety and environmental protection education system and regular inspection system. These personnel, technical scheme and work plan requirements are unique in the Rules, not seen in the Regulation and the Standards. However, the legal level of the Rules is very low and developed very long ago, and some of the provisions do not meet Green ship-recycling ideas for safety and environmental protection, at the same time, the contents of the Rules are not detailed and specific, sometimes it is difficult for implement and operation.

Technical Guidelines of Environmental Pollution Prevention by Ship-recycling is developed by the CNSA, which mainly focuses on hazardous wastes generated by ship-recycling and their harm, measures and requirements for prevention of environmental pollution by ship-recycling, environmental management and monitoring related to ship-recycling. The CNSA, also the maker of the Standards, is the only industry organization of ship-recycling industry officially registered and

approved by the Ministry of Civil Affairs of the People's Republic of China. Without legal authorization, its technical guidelines do not have the force of law, only have limited binding on its members.

Regulation on Prevention of Marine Pollution from Ships gives explicit requirements on site of ship-recycling facilities, fitting of emergency equipment, safety production and pollution prevention measures, operation inspection and approval. The promulgation of this Regulation will improve the level of safety and environmental sound of China’s ship-recycling industry. But unfortunately, this Regulation is not particular for ship-recycling industry.

3.2 Green ship-recycling in China

In recent years, China has paid more and more attention and effort to green industry, and green ship-recycling is an important one, especially after the HKC was adopted, the General Standards for green ship-recycling is quite match with the HKC to some extent. With the attention by the government, the injection of capital and technology, China’s green ship-recycling has been a step forward of the world's major ship-recycling countries. The implementation of the HKC and the new ERSRR is only a question of time, thus it become necessary to continue to promote the benign development of Green ship-recycling, maintain the advantage position, improve the competitiveness of ship-recycling industry, and make China’s voice louder in the international ship-recycling field becomes necessary.

3.2.1 National development plan on green ship-recycling

Long-term Science and Technology Development Plan (2006-2020) made it clear: To

actively develop green manufacturing, accelerate relevant technology usage in development and design of materials and product, machining and manufacture, sales and service, and recycling of products in its whole life, form a highly efficient, energy saving, environment friendly and recyclable manufacturing process, make manufacturing resource consumption and environmental load into international advanced level. In addition, the National Development and Reform Commission issued Decree No. 9 of 2011 and announced a new Guiding Catalogue of Industrial Structure Adjustment (2011), in which Article 38 lists waste products and parts like scrapping ship as comprehensive utilization of environmental protection and resource conservation. The Catalogue is an important basis for the government to guide the direction of investment, manage the investment projects, develop and carry out of taxation, finance, land, import and export policies. This is the first time for ship-recycling industry to be contained, which will have an important impact on positioning and sustainable development of China's ship-recycling industry.

China’s ship-recycling industry is resource saving and environmental protection industry gradually develops with the reform and opening up policy. According to the request of Shipping Industry Restructuring and Revitalization Plan approved by the State Council, developing of ship-recycling industry which is an important part of the complete industrial chain together with shipping and shipbuilding industry is conducive to promote the benign development of shipping and shipbuilding industry. Ship dismantling is called ship-recycling in the world range, it is not just reuse, it also plays a very active role in resource conservation, environmental protection, energy conservation, expanding domestic demand and increasing employment.

3.2.2 Research on key standards of green ship-recycling

With no doubt green ship-recycling is the world’s trend. As is analyzed above, both the international and domestic circumstance shows that it is the right and important time for China to develop ship-recycling industry, and competition is ongoing, so keep on promoting green ship-recycling is crucial.

Recently, under the lead of China Shipbuilding Technology and Economy Institute, involved by CNSA and Beijing Central Green Boat Electronics Development Company, a special research project that researches on key standards of green ship-recycling was approved by the National Standardization Management Board in 2013 (Ou & Luo, 2013). The purpose of the project is through the analysis of the current technological development trend of the world's major ship-recycling countries to understand their perspective, learn the main technical content of domestic and international conventions, rules, standards, etc. for in-depth analysis, and analyze the impact of international Ship-recycling Convention on China's ship-recycling industry and shipbuilding industry. Meanwhile, combined with the current situation and development of the domestic ship-recycling industry and the application of international convention and standards, strategies and recommendations are proposed on development of 6 national ship-recycling standards: China’s Green ship-recycling technology and related standards, and to develop General Standards for Green ship-recycling, Information Management Requirements of Hazardous Substances During Shipbuilding and Ship Operation, Implementation Guidance on ISO30000, Measures on Prevention of Asbestos Exposure When Ship-recycling, General Method on Ship-recycling Facility Assessment and Planning. The key technology of this research project is to analyze the gap between China’ ship-recycling industry and the International Ship-recycling Convention, and propose development strategies and recommendations from the technical view.

1. Research on general technology of green ship-recycling. According to requirements by top level of international environmental protection on ship-recycling, combined with the actual technical situation of various ship-recycling facilities, research and analysis on the foundation in all aspects of ship-recycling, general environmental protection and safety technology are carried out; common technical needs of Green ship-recycling are raised, General Standards for green ship-recycling is summarized and develop.
2. Research on technical needs and standards on hazardous substances information management. Hazardous substances of ship come into existence from design, construction, and equipment procurement, how to manage and use the huge information of hazardous substances in the whole ship-life to prevent pollution caused by them during construction, operation, modification and recycling period is quite difficult and widespread concerned by the ship operators, managers and supervisors. The classification societies have already started making programs, trying to lay full management of hazardous substances. The Project will carry out a comprehensive research and analysis of the requirements of the information management, and develop Information Management Requirements of Hazardous Substances during shipbuilding and ship operation.
3. Measures research on harm prevention by asbestos during ship-recycling. Asbestos is a widely existing hazardous material in the ship but prohibited of usage by International Conventions because it is very harmful for human and environment. Although its usage has been prohibited, for existing ships there are huge amount of asbestos. The project will research and summarize the technical measures to minimize the hazards of asbestos, examine and develop Measures on Prevention of Asbestos Exposure When Ship-recycling.
4. General methods research on ship-recycling facility assessment and planning.

Through extensive research and comments, green ship-recycling practice based on ship-recycling facilities is carried out; measures and suggestions on implementation of International Conventions by ship-recycling facilities are proposed; evaluation methods by ship-recycling facilities to practice Green ship-recycling are researched; and General Method on Ship-recycling Facility Assessment and Planning is developed.

5. Research on international standards and their implementation. Once International Conventions and Rules about ship-recycling by IMO came into force, they will be mandatory. And it for sure will be implementing in China as a big shipping country. The IS030000 is an international standard with detailed requests to implement IMO conventions. The project will combine China's recycling facilities' actual condition with the requirements of IS030000, make in-depth analysis and research, propose measures about how to meet the international requirements, and develop Implementation Guidance on ISO30000.
6. Research on technology and standards of yacht recycling. At present, the domestic ship-recycling companies basically can recycle all types of vessels, including tankers, container ships, fishing boats and LNG vessels. With the rapid development of world and China's yacht industry, demands have increased for yacht recycling. The project will analyze the potential harmful substances of yachts, and carry out preliminary studies on the yacht recycling techniques.

The Project is the first time for China to carry out key technologies and standards research on Green ship-recycling area, thus exerting very positive influence on China's Green ship-recycling.

4 Analysis of China’s competitiveness

Now the internationally renowned ship-owners show more and more value on whether the ship-recycling company meets green requirements of environmental protection, which makes the ship-recycling companies strive to meet international standards. Therefore, with the market increasing, the competition will become fiercer. Although the level of safety and environmental protection of China's ship-recycling industry is ahead of other major ship-recycling countries, and some ship-recycling companies are world-renowned, other countries are catching up under international requirements, and countries like Bangladesh and India have already gradually begun to realize the importance of safety and environmental protection in the development of ship-recycling industry. For instance, India has carried out certification of ship-recycling companies relying on ISO 30000 series of standards, and Bangladesh stopped imports of scrapping ship during 2010 to 2011 to reorganize its ship-recycling industry for more safety and environmental protection, which lays down foundation for the next step of green ship-recycling and exploration of the international market. For the major ship-recycling countries besides China, India is the most competitive opponent with the request of the international convention, so in this section Michael Porter Diamond Model will be used to analyze the competitiveness of China’s ship-recycling industry compared with India under new economic and legal environment. And then, SWOT method will also be used based

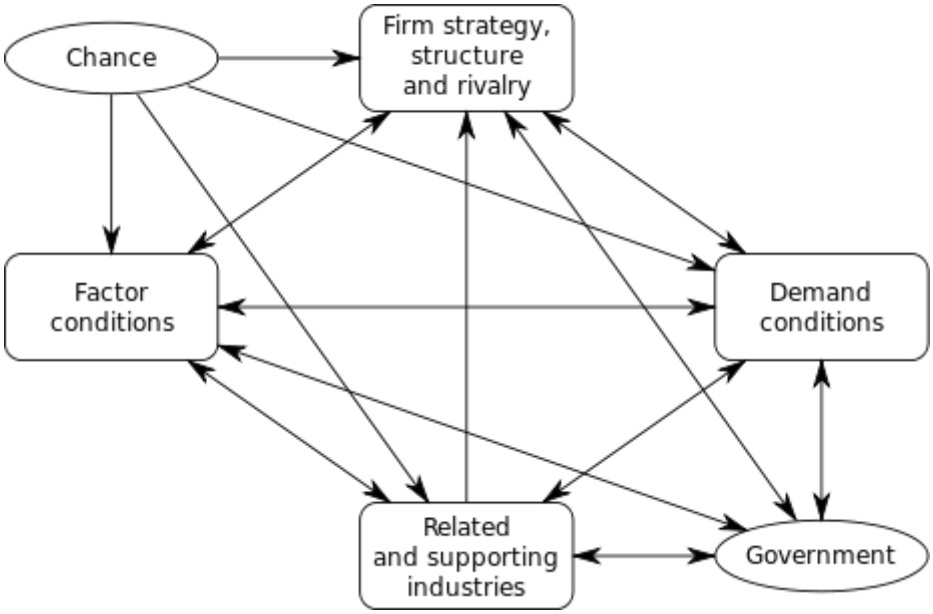
on the Michael Porter Diamond Model and other aspects to figure out China's weaknesses.

4.1 Michael Porter Diamond Model

The Diamond Model is an economical model developed by Michael Porter in his book *The Competitive Advantage of Nations*, in where he published his theory of why particular industries become competitive in particular locations (Wikipedia website, 2014).

Porter believes that there are 4 technical factors and 2 influential factors influencing each other, which forms a chart of a diamond pattern and determines the competitiveness of an industry.

Figure 5 Michael Porter Diamond Model



Source: Wikipedia, 2014

The technical factors:

Factor conditions: human resources, physical resources, knowledge resources, capital resources and infrastructure.

Demand conditions: domestic market demand.

Related and supporting industries: whether there are domestic relevant industries that have international competitiveness.

Firm strategy, structure and rivalry: the way that companies are created, set objectives and managed.

The influential factors:

Government: which can influence any one of the technical factors, and also the way adverse.

Chance: events happened out of control. (Baidubaike, 2014a)

4.1.1 Factor conditions

4.1.1.1 Natural conditions

China has a long coastline, and ship-recycling companies are mainly distributed in the Pearl River estuary and the Yangtze Delta and recycling on dock or boatyard. Alang of India has deep water and big tide, with tide range of about 10-11 meters, which is very suitable for ship even big ones like VLCC to beach, and special mooring after beaching is not needed, so this way is widely used in India. Under the trend of environmental protection and the international conventions becoming effective, undoubtedly China takes greater advantage.

Besides, China's ship-recycling activities are less affected by seasonal variations due to the concentrated areas with distinct seasons. But India is in the tropical monsoon

climate, during the rainy season, heavy rains and typhoons affect Alang areas greatly, reducing the recycling efficiency.

4.1.1.2 Human resources

As a labor-intensive industry, ship-recycling industry is quite relying on labor resources, which can be seen from the transfer of scrapping center. This section will discuss the status of human resources from three aspects: workers' quantity and quality, education and training system and labor costs.

1. Workers' quantity and quality. Major ship-recycling countries are developing countries, with the most densely populated in the world, and they can provide a larger amount of cheap labor for ship-recycling industry. India currently has nearly 25 million workers directly engaged in ship-recycling industry. The majorities of them are migrant workers, aged from 18 to 46, and about 2% are child labour (Wu, 2012). Most workers are illiterate or only have primary education and very few technical and safety training before working.

In China, the quality of personnel of the workers is better. There are about 10 million ship-recycling workers in China. And a considerable part of them are migrant workers who have better education than the other two countries because of compulsory education. More than 40% of them have been to junior high school (Wu, 2012). Before entering the industry, most of them get a period of pre-service professional training. Workers engaged in different types of work are required to hold qualification certificates or operation permission, with particular expertise. And child labor is almost eliminated in China. India takes advantage in labor supply, which also should be considered in combination with technic. But China has an absolute

advantage in labor quality.

2. Education training system of ship-recycling industry. 34% of India's ship-recycling workers are unskilled workers, and even some skilled workers have not received any formal training. In recent years, India has begun to focus on technical knowledge education and safety training of ship-recycling workers, and relevant investment has gradually increased (Wu, 2012).

China is a big ship-recycling country and at the same time is a big shipbuilding country, with a lot of ship-related professional experts. Under the encouragement of national policy, colleges and universities pay a lot of attention on the education of fields relevant to ship industry. According to incomplete statistics, 102 colleges and universities set up ship-related majors, and 80% of the technical schools have opened ship-related professional education programs (Wu, 2012). And all the regular ship-recycling companies in China have established vocational training system for occupational safety and better management.

3. Labor cost

Labor cost is associated with the level of a country's economic development. The higher the development, the higher the wage is. After independence India has achieved great economic development and become one of the fastest growing countries. But India’s ship-recycling workers' wage is far below the minimum basic wage of domestic requirement; the average daily wage is only about $3 (Wu, 2012). With the development of India's economy and the deepening awareness of workers’ labor rights, wage level for ship-recycling workers is gradually increasing, and the proportion of labor costs by total cost of the ship-recycling industry has increased.

China's economic growth draws the world's attention after reform and opening up policy, the overall wage level is higher than that in India. The month salary of a ship-recycling worker is above 3 thousand (more than $15 per day), and companies need to pay social insurance (Wu, 2012). In recent years the labor shortage and rising wages have led to a further increase of labor costs.

4.1.1.3 Knowledge and technology

Ship-recycling technology not only focuses on recycle, but also includes technics like recycling process design, environmental protection and pollution prevention, the handling of hazardous materials, safety protection and product processing. China's ship-recycling industry operated on dock or dockyard with mechanical operations, recycling techniques, safety and environmental protection has achieved a higher level after decades of development. India's beaching method with simple process and equipment, cannot offer effective protection for workers and environment.

4.1.1.4 Financing advantage

Ship-recycling industry needs huge long-term investment, and has big business risk due to market volatility. So by means of bank financing to purchase scrapping ships has become an important way for ship-recycling companies.

Ship-recycling companies can hardly get loans from European banks after influence of 2008 financial crisis. Open letters of credit issued by Indian bank are hardly recognized by foreign banks, and many ship-recycling companies face a shortage of cash flow. But China can pay ship-owners by sufficient foreign exchange reserves and relaxation of domestic economic policy, which is a great advantage in terms of

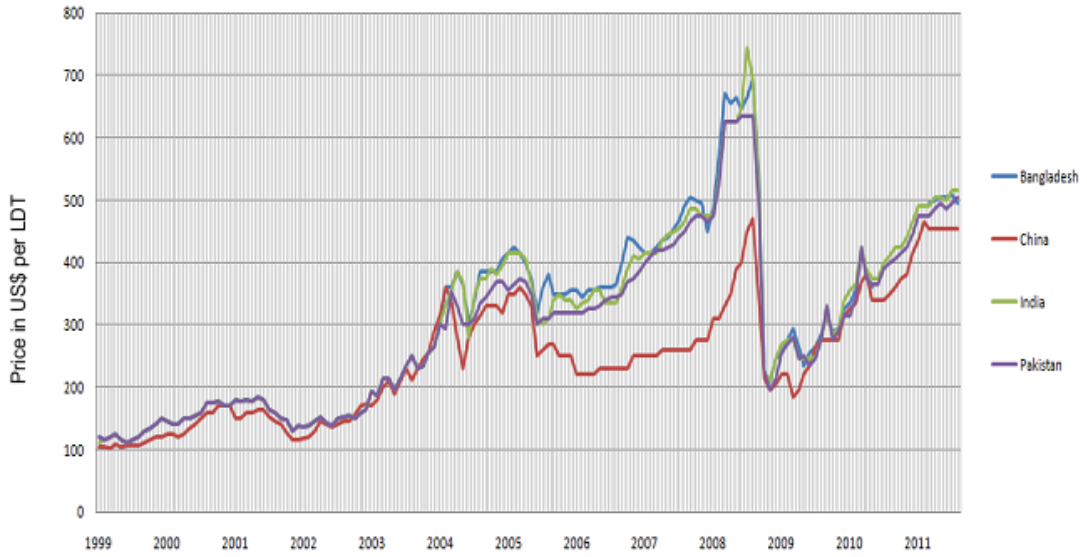
attracting ship-owners.

4.1.1.5 Infrastructure

As discussed above, the beaching way by India gets backward both in technic and equipment and leads to frequent industrial accidents. But in recent years, with a higher global requirement of ship-recycling industry and higher environmental requirements by domestic laws, the investigation in technology and equipment by the government and companies has increased greatly, and the number of industrial accidents has significantly reduced, from annual average of 48 casualties to 25 or less today. China is much better with advanced technology, equipment and technical input. The industry of China invested 320 million RMB in environmental protection in the “Tenth Five Years” period (Wu, 2012).

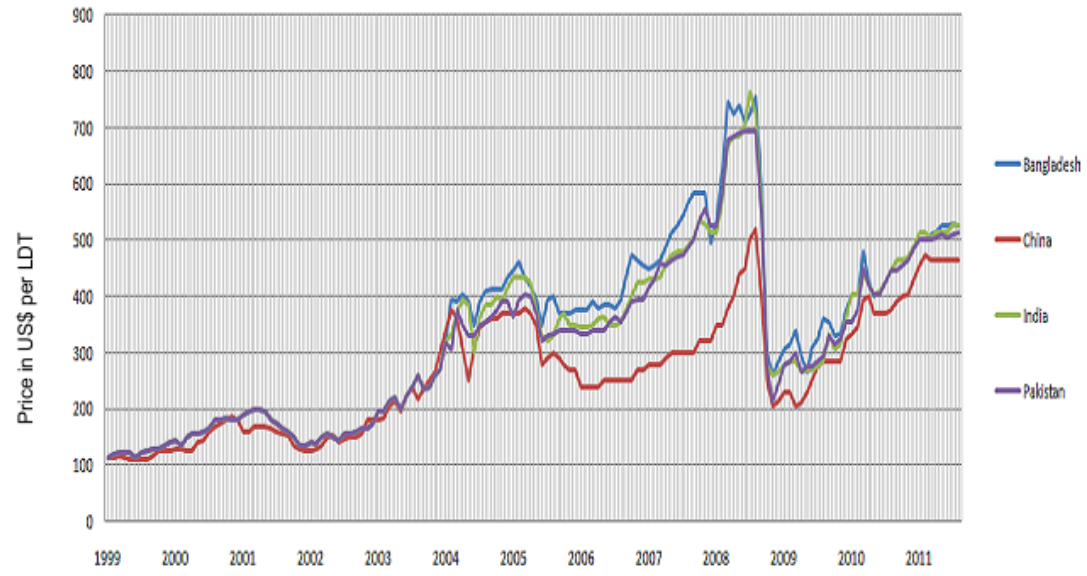
But the recycling cost raised up by plenty of investigations, has resulted in China’s scrapping ship price being the lowest of the major ship-recycling countries. And once the market goes down, huge amount of money and resources will be wasted. But what can be expected is that with the implementation of the international convention, these disadvantages will be reversed to advantages, and thus enhancing China’s competitiveness.

Table 6 Average demolition prices for dry cargo ships, by country of recycling



Source: Mikelis, 2012

Table 7 Average demolition prices for tankers, by country of recycling



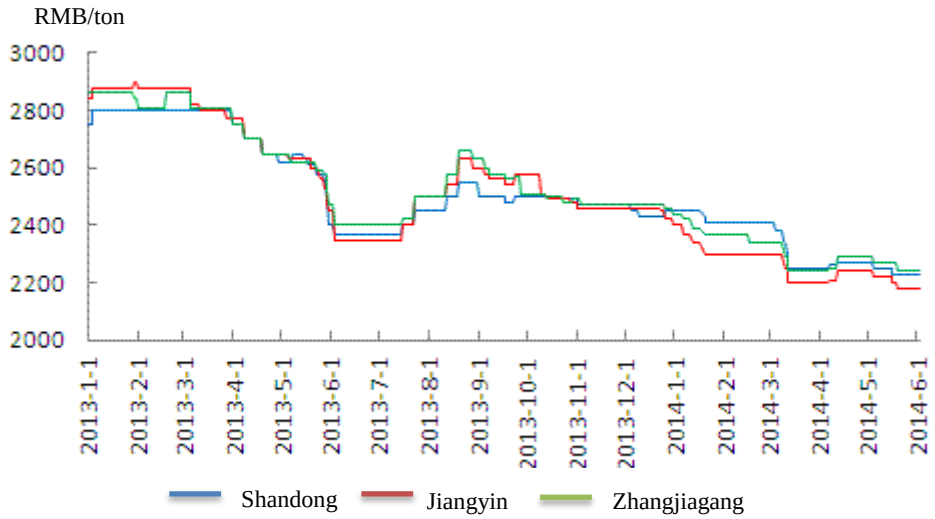
Source: Mikelis, 2012

4.1.2 Demand conditions

Scrap steel is the main product of ship-recycling, up to 70%, and makes 90% of the income, thus the demand of scrap steel is the key power for ship-recycling industry. Indian steel industry expanded rapidly under the economic liberalization policy since the early 1990s, and large steel demand has been created by domestic construction industry. Although India is one of the world's largest ten steel-producing countries, it is also a net steel import country. According to the Indian Bureau of Statistics, the average annual steel production amount was 50 million tons, and 6.8 million tons of import annually, but the total demand was up to 58 million tons per year, where big gap exist. The developed India ship-recycling industry provide about 0.1-0.2 million tons of steel, which accounts for about 2.5% of the total demand (Wu, 2012). The strong demand of steel has greatly promoted the development of India's ship-recycling industry.

In the last 20 years, steel production and consumption improved significantly due to the fast development. But recently, China is facing the growth slowdown and steel production overcapacity, which results in a fall of scrap steel prices and the risk of losses for ship recycling companies.

Figure 6 Scrap steel price in several China areas



Source: China custeel, 2014

Besides scrap steel, there are other products like wood, equipment, non-ferrous metals, furniture, household items and so on. The scrapping supplies are very popular in India, which is supported by well-developed secondary market. But they are rarely re-used in China, 90% of which go to Recycling field.

India's steel demand is far more dependent on the ship-recycling industry than does China. The same as recycling of other scrapped materials, India takes big advantage of scrap steel recycling.

4.1.3 Related and supporting industries

Shipbuilding industry, shipping industry, ship-recycling industry and steel processing industry together make a complete industrial chain. The ship-recycling industry is enormously impacted by the development of the other three.

4.1.3.1 Shipbuilding industry

On the whole industry chain, there exists resource sharing and industrial cycle complementation to a certain extent. Knowledge and technology, equipment and human resource can be shared by both of them. Furthermore, they take turns, the peaks and valleys of shipbuilding industry corresponding to the low and high tide of ship-recycling industry, so the resources and information can be interoperable to save resources and achieve their common development. China is a big country in both shipbuilding and ship-recycling and takes big advantage in this area. Since 2008 economic crisis, because of the recycling capacity short supply while shipbuilding overcapacity, some shipbuilding companies temporarily use shipbuilding resources to recycle ships, and flexible adjustment is used to enhance the international competitiveness. In India, although th**e** shipbuilding industry has developed, and has big potential, it has not reached a larger scale, now the shipbuilding industry witnesses downturn, a lot of new small shipbreaking companies spring up, development disorder has a big potential of waste resources and prosperity after boom.

4.1.3.2 Shipping industry

The amount of scrapping ships supplied by the shipping industry determines the rise and fall of the ship-recycling industry, by the impact of various factors. The international shipping market is same to the recycling countries.

4.1.3.3 Metal processing industry downstream

Scrap metal processing industry is the downstream industry of ship-recycling.

Xinhui District of Jiangmen is known as the "ship-recycling base" in China, ship-recycling companies there try hard to develop the manufacture downstream products, with an annual output of 1 million container corner sets, 300 million tons of steel section which accounts for more than 50% of the total, and 100 million tons of precision seamless steel tubes that makes it one of the biggest production bases (Jiang & Xu & Tang, 2009). Besides, it takes the lead of more than 100 small and medium private companies that produce various steel productions, providing 600 working positions and another 1 thousand person to provide logistics, transportation, catering and other services for these companies (Wu, 2012). An industrial cluster led by ship-recycling industry, dealing with scrapping, recycling and future processing, has basically taken shape. But this kind of industrial cluster only exists in some big ship-recycling areas, the distribution of China’s recycling facilities are relatively disperse and most of the major ship-recycling companies just scrap and sell the steel and other products. There is no extension of the industrial chain development, nor are there no corresponding industrial clusters.

India's scrap processing industry is quite developed. 90% of India's ship-recycling industry is located in Alang area. Apart from 5 thousand waste recycling companies, there are nearly 1 thousand small scrap steel processing enterprises. As the ship-recycling companies and large-scale of downstream processing enterprises gather, together a reaches significant scale effect is produced. Regional economic development of Alang ship-recycling industry is supported by industry clusters, and backed up by strong domestic demand for steel.

As is shown in the above analysis, the development of China's ship-recycling industry is supported by developed shipbuilding upstream, and it has great advantage in adjusting ship-recycling capacity. Development of India scrap downstream

processing industry cluster for the upstream development of ship-recycling industry has provided a powerful impetus.

4.1.4 Domestic competition and corporate strategy

As mentioned above, because of the international market fluctuations and domestic policy adjustments, etc., the number of ship-recycling companies also fluctuates widely up to more than 200 and down to about 10 when depression. Today the scale is relatively stable, with the number around 90 after several fierce intra-industry competitions and industry selection, with the annual recycling capacity being about 3.5 million LDT (Wu, 2012). After fierce competition, a number of leading companies showed up, mainly located in Jiangmen and Xinhui in Guangdong, and Jiangyin in Jiangsu. Take Jiangmen Yinzhouhu area for example, the recycling capacity is about 2.5 million LDT, which take up 50% -60% of the national volume, totaling 150 ships, and at the same time it become industrial clusters as discussed above (Wu, 2012). In terms of business strategy, China's ship-recycling companies are following "Green ship-recycling", with more advanced technology and relatively better environmental protection and sound management system, to promote China's ship-recycling industry's international competitiveness.

India now has more than 180 ship-recycling companies which are mainly located in the Lang area, and the market share is decentralized, with no recognized leading companies. The competition is very fierce due to no significant differences between the companies. Shipbreaking market structure is a competitive market which is dominated by price war, although it grows rapidly, it is not conducive to the international competitiveness.

One strategy of India's ship-recycling industry is to make benefit from second-hand products, at the same time the needs improve the recycling technics, which uses downstream demand to promote the growth and development of ship-recycling industry and enhance the international competitiveness of the Indian ship-recycling industry to some extend.

4.1.5 Government

From the development history of ship-recycling industry, it is clear that it needs vigorous support from the developing countries' government, and its success or failure depends largely on national industrial policy. National emphasis on an industry can reflect its preferential policies, industry guidance policies, regulations and other aspects.

4.1.5.1 Tax policy

The preferential policies have big influence on the development of ship-recycling industry, which can be seen from the relevancy between changes of the policies and activity level of the industry and tax incentives is the most significant one. The impact of China's tax policies on the ship-recycling industry has been discussed in Chapter 1. Now VAT and customs duties of imported scrap ship is 17% in China, and the total negative tax is 20.51% for ship-recycling companies (Wu, 2012); besides, the cost of China's ship-recycling companies is higher than others, so the international competitiveness has been weakened to some extent.

India's ship-recycling industry has maintained a strong competitive advantage, which is inseparable from the government support policies. From around 1991, India has

adopted a series of policies on economic liberalization, abolished restrictions on the import of scrap vessels and adopted preferential policies on taxation instead, collecting 15% of import tariff on scrap ships, while limiting import of steel, ship plate and billet steel with high import tariff, this policy have indirectly supported the development of ship-recycling industry (Wu, 2012).

4.1.5.2 Domestic law and regulations

China's laws and regulations have been introduced in the second chapter, which shows that the legal system of China's ship-recycling industry has a long way to go. Now there are more guidelines, recommendations, industry standards and policy guidance in the ship-recycling legal system, which without legal mandatory while the binding one is out of date and lack of operability. Meanwhile, there are a lot of regulatory loopholes, and plenty of work need to be done.

India used to only value the economic benefits of the ship-recycling industry without enough attention paid to environmental protection and safety problems, and this industry is lack of supervision. But now with the international community's attention, the Indian government has started to increase regulation on the ship-recycling industry and improve the industry standards gradually. India’s government regulation of the shipbreaking industry is more stringent than before, epically for oil tankers recycling, in which scrapping single-hull oil tankers are forbidden in some area. Pre-cleaning and outgassing are required for the tankers to be recycled. India was once a big tanker recycling country, and it turns to bulk carriers today, and has become the largest bulk carrier recycling country since 2008.

4.1.6 Opportunity

For ship-recycling countries, there are a lot of external factors that can affect the development of its and the world's ship-recycling industry pattern, like adjustment of exchange rate, or a related technology breakthrough (such as steel-making technology and ship-recycling technology), a major decision by other competitors or international regulation implementation or change. And now the biggest opportunity for the industry is the major adjustment of international regulation, the HKC and the new EUSRR, which is an important opportunity for China.

4.2 SWOT analysis

SWOT analysis is very popular as a structured planning method which is based on the internal and external situation under competitive conditions, through surveys list of internal (strengths & weaknesses) and external (opportunities & threats) that related to the research subject to apply system analysis, and get a range of appropriate conclusion, which can be used for decision-making (Baidubaike, 2014b). The analysis will combine with the result of Diamond Model analysis above and other relevant aspects, trying to find out the weaknesses and threats of China's ship-recycling industry.

Table 7 SWOT analysis on China's ship-recycling industry competitiveness

	Internal		External	
	Strengths	Weaknesses	Opportunities	Threats
Natural conditions	Mainly distributed along or at the estuary of the river; slightly affected by seasonal variation.	None apparently.	N/A	N/A
Human resources	Sufficient labor with good quality; comprehensive work training; good education system on relevant majors.	Labor cost higher than other major ship-recycling countries; none specialized major on ship-recycling.	None apparently.	Labor cost of other major ship-recycling countries is much lower, which can earn ship-owners' favor.
Knowledge and technology	Profit from ship building development, achieve a much higher level than other major ship-recycling countries.	Compare with the international conventions, gap still needs to be filled.	Achieve higher level under the requirements of the international conventions.	None apparently.
Financing	Financing is not hard.	None apparently.	None apparently.	If economical situation and steel price go down, there will be a problem.
Infrastructure	Input plenty of money on technology and equipment, recycling on dock or boatyard in advanced way.	With high cost, the scrap ship price is the lowest compared with other ship-recycling countries.	The requirements of the international conventions are quite high and China is more closed to them.	Other countries like India is catch up.
Demand conditions	None apparently.	Domestic steel production overcapacity, low price of scrap steel; re-use of other product is very limited.	None apparently.	None apparently.
Related and supporting industry	Strong support by ship building industry.	The downstream market is not active, the formation industry clusters is not enough.	International ship-recycling market boom.	None apparently.
Domestic competition and corporate strategy	The domestic market is relatively stable with several leading companies; the Green ship-recycling strategy has developed for years.	The business of the ship-recycling companies is unitary; illegal ship-recycling activities disrupt the market; low management level.	None apparently.	None apparently.
Government	Has already realized the importance of the industry and has the motive to promote it by its development plan; put effort in Green ship-recycling for years.	Tax for ship-recycling companies is too high; legal system is out of date and not comprehensive; regulatory body is not clear.	The HKC and ERSRR develops high request for the industry, which is a good opportunity for the government to promote the development of the industry.	N/A

4.3 Weaknesses of China's ship-recycling industry

Based on the analysis above, the weaknesses of China's ship-recycling industry can be concluded:

For the ship-recycling companies:

- Low profit margins, even suffer losses under the boom period.
- Overcapacity of domestic steel production in recent years, lowers the price of scrap steel;
- Most of the companies only make profit from scrap steel and lack further processing, and re-use of other products is very limited;
- High cost on labor and green ship-recycling;
- The formation of industry cluster is not enough;
- Ship-recycling industry suffers high tax cost;
- Illegal ship-recycling activities disrupt the market and bring about high risks for environment and safety.

For the Government:

- Legal system is out of date and not comprehensive, with big gap between the international regulations;
- Lack of industry guidance and preferential policies;
- Overtax of this industry;
- Lack of market access mechanism;
- Regulatory body not clear and supervision is not totally in place;
- No mechanism of whole-life supervision over ships.

5 Conclusion and Recommendations

5.1 Conclusion

With the change of the international economic situation and the trend of the implementation of international conventions, competition pattern of international ship-recycling industry may be adjusted again. This dissertation attempted to analyze the competitiveness of China's ship-recycling industry under the new situation and give recommendations. Firstly, the characteristics of ship-recycling industry are described to explain why China should put effort in developing the industry and take it as a national strategic industry. Then the history of the industry, both international and domestic is described and combined with its status quo to show that the industry center may transfer again and China is likely to be the next center. After that, the international and China's legal system on the industry and green ship-recycling development in China are introduced, and highlight the revolutionary regulation--the HKC. Next, China's achievements and backwardness are discussed, followed by identification of the domestic and international environments to analyze China's competitiveness with Michael Porter Diamond Model and SWOT analysis. Finally, the weaknesses of China's ship-recycling industry are pointed out and recommendations related to the promotion and development of China's ship-recycling industry are made.

5.2 Recommendations

Now ship-recycling industry is under a booming period. Taking the global and China's fleet number and ship's life time into account, the market keeps in high position for a long time. China has a better foundation on ship-recycling industry than other major ship-recycling countries. Under the new environments, both internal and external conditions provide opportunity, so it is time for China to map out development strategy to gain the advantage, preparing to lead the industry. The following are some recommendations based on the analysis above:

5.2.1 Recommendations for the government

1. The government should study the Convention and its technical guidelines in depth, make use of China's advantages on technology and shipbuilding, actively participate in the amendment proposal of the Convention and relevant guidance, research the impact on the industry by the implementation of the Convention, all of which will provide basis for decision-making. At the same time, promote the development of the Convention combined with China's own situation so as to protect the domestic industry when the time is ripe.

2. As a big shipbuilding country, the growth and development is closely related to human resource. China's ship-recycling industry has taken great advantage from the foundation of reserve of talents cultivated by shipbuilding and related industries. Currently there are specialized talent education and training for shipbuilding and repair. Although there are a lot of commonalities, the international conventions still give high requirements, especially in environmental protection, handling of hazardous materials, processing

supervision, personnel protection, etc. The government should take increasing specialized majors into consideration, to train comprehensive talents for ship-recycling and reserve force for the future development.

3. Green ship-recycling is a key advantage of the shipbreaking industry of China. That should be kept going on, which is inseparable from the policy formulation and guidance system of the government. Firstly, a layout for the industry should be made to establish industrial clusters with large-scale. Our ship-recycling industry has formed a pattern that two centers located in the Pearl River Delta and Yangtze River Delta, and several small ship-recycling yards along the coastal region. In some areas, the industrial clusters have produced good economic returns. Now the total recycling capacity of around 3 million LDT is appropriate, and there is no need to increase investment and expand more land. Through mergers, restructuring and acquisitions will be consolidated into a few large companies to achieve high competitiveness by means of scale advantage. Secondly, the integration of ship building, repairing and recycling should be encouraged, competitiveness by optimized allocation of resources should be enhanced. Since the centers of ship-recycling are also ship building centers, existing labor, facilities and management resources can be fully used due to the resource interoperability and cycle complementarity, to save cost and improve competitiveness. Thirdly, preferential policies should be given to stimulate the development of the industry. Currently taxes for ship-recycling companies are too high, coupled with a single way of profitability, high cost and low scrap steel prices. Even at the boom period of ship-recycling market, the companies still face losses. The government should reduce tax burden of the industry or give tax refunds. Meanwhile, foreign experience can be learned to establish ship-recycling fund by various ways to disperse the risk, and encourage the development of the

industry. Fourthly, the development of downstream industries should be encouraged, like giving preferential policies to scrap steel processing companies under the view of environmental protection and promoting sustainable development to encourage the development of the industrial chain.

4. The government should improve development of laws and regulations, and strengthen market supervision. As previously mentioned, China's ship-recycling legal system needs to be improved, and a comprehensive and mandatory law with high maneuverability on ship-recycling relevant to the international Conventions' requirements should be developed and combined with mandatory technical guidelines. Also, the regulatory body should be clear, and supervision should be strengthened. Market Access Mechanism should be established with high standards; high pressure should be on illegal recycling and the companies under standards, build up scrap ships track system should be built up to carry out full supervision over ship-recycling.

5. The government should actively participate in international cooperation and exchange. It is certainly that the management of safety, environmental protection and occupational health of ship-recycling industry in China are still far behind developed countries. China should actively learn the advanced experiences, to enhance our technical and regulatory level and promote the implementation of the HKC when ready.

5.2.2 Recommendations for the companies

1. Find out more profit growth points, like deep-processing ship-recycling products, carrying out comprehensive utilization and extend the product chain. As

mentioned above, Xinhui District of Jiangmen has already formed industrial cluster, and the companies chasing for deep-processing and higher value have added products themselves and achieved good economic benefits, which is good to learn from. Besides, the experience of India is also a good trying, since it has enriched the products of ship-recycling and enhanced profitability.

2. Enhance core competitiveness, take green ship-recycling as guidance, take safety, environmental protection and occupational safety and health as baseline, and improve technology and management level. The leading companies should meet the requirements of the HKC earlier, to earn reputation in the world's market and sign long-term contracts with the shipping companies, which will provide a way for foreign shipping companies to recycle ships greenly, and also improve the visibility of China's ship-recycling companies. Besides, the stability of China's market share should be ensured, while improving the technical level.

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